State of CERES

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CERES Science Team Meeting, May 15-17, 2018
NASA LaRC, Hampton, VA

CERES Meeting

Review status of CERES Instruments and Data Products:

- Status of CERES
- CERES Terra, Aqua, S-NPP, NOAA-20 SW/LW/TOTAL Channel Calibration Update
- MODIS & VIIRS Cloud Algorithm & Validation Status
- ADM, SOFA, SARB and TISA Working Group Reports
- FLASHFLUX Update
- Data Management Team Update: Terra/Aqua/S-NPP
- Atmospheric Sciences Data Center (ASDC) Update
- CERES Communication Activities

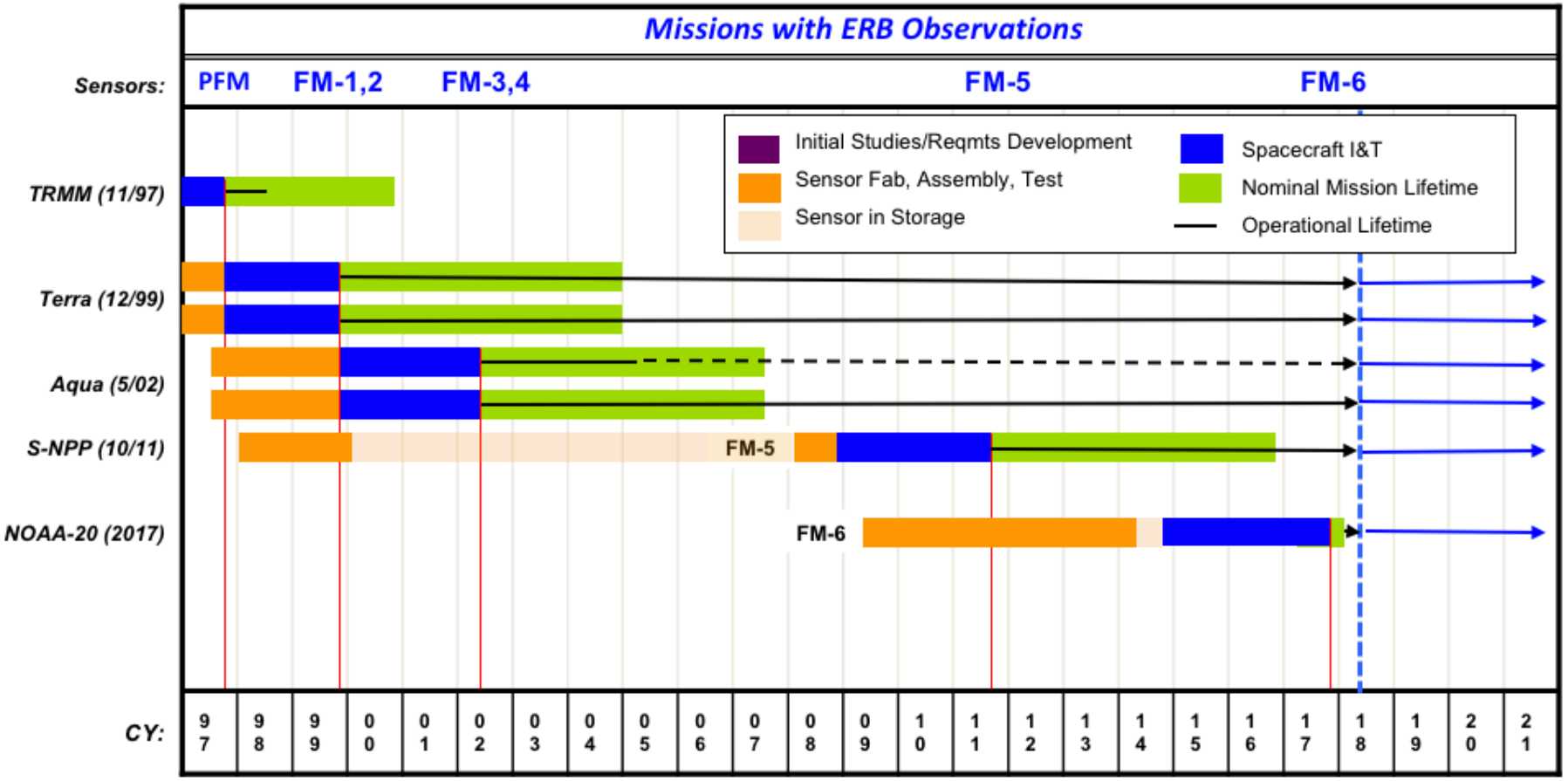
Successful JPSS-1 Launch!

The Joint Polar Satellite System-1 lifted off from Vandenberg Air Force Base, California, on November 18, 2017 at 1:47 a.m. PST.

RBI & Earth Venture Class Continuity

- Radiation budget instrument termination on January, 2018 due to cost overruns.
- NASA HQ is developing a programmatic plan and associated schedule and budget that would enable an instrument capable of continuing the CERES radiation budget measurements.
- ERB Science Working Group of Civil Servants will inform NASA on ERB observational requirements.
- New instrument will be competed under a Venture-Class Continuity announcement of opportunity in early 2019.
- Data from this new instrument will be incorporated into the existing CERES ERB climate data record at LaRC.

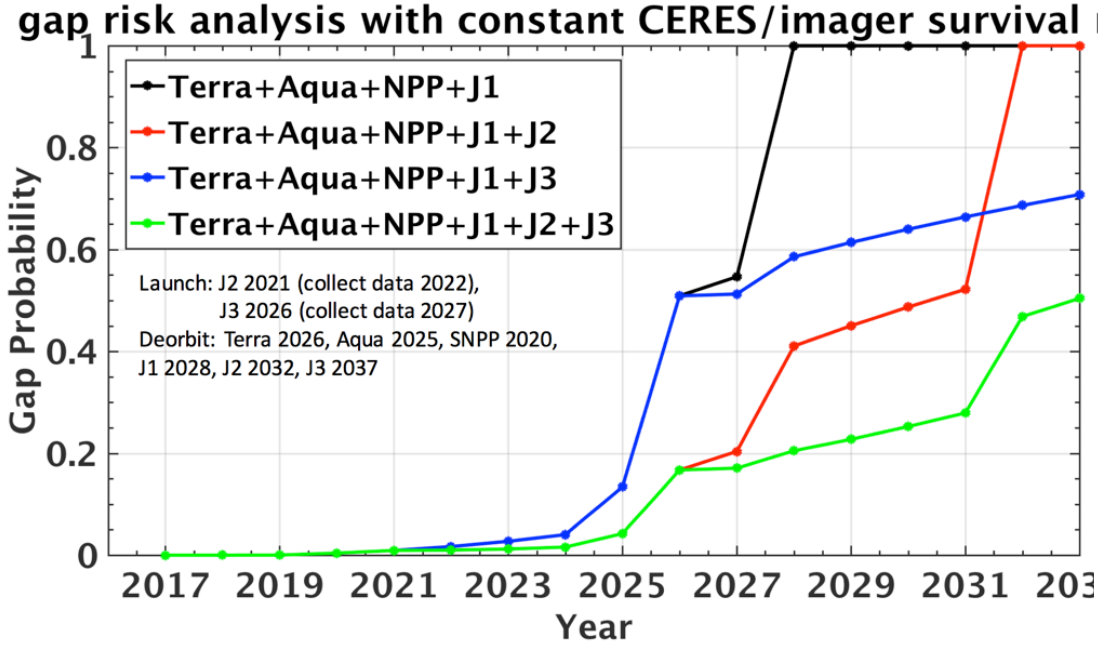
CERES Flight Schedules



- Currently, 6 CERES instruments fly on 4 satellites: Terra (L1999), Aqua (L2002), SNPP(L2011), NOAA-20 (L2017)

ERB Gap Risk Analysis

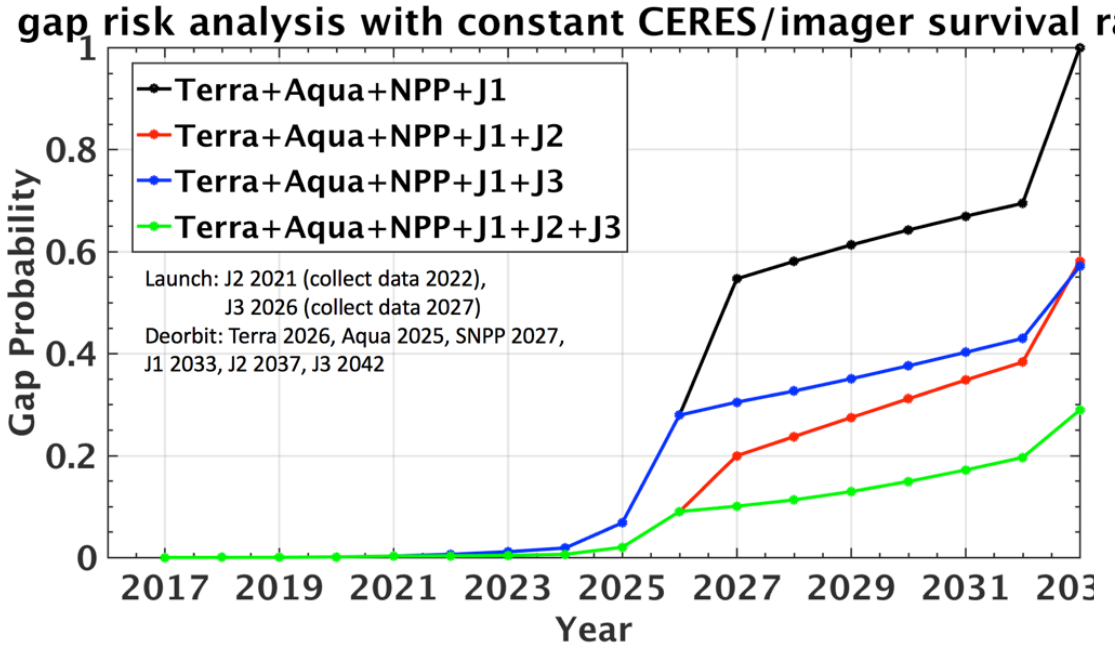
Assumptions:
- Constant CERES, imager & spacecraft survival rates.
- Fuel is the only limiting factor for Terra & Aqua de-orbit dates
- 8-year mission for S-NPP, 10-year missions for J1, J2, J3
- J2 launches in 2021 and J3 launches in 2026
- EV-C ERB instrument can be accommodated on J3



- The probability of a data gap in the ERB record reaches 51% in 2026 if no CERES follow-on launches before 2026.
- Had RBI flown on J2, the gap probability would have remained < 20% in 2026.

ERB Gap Risk Analysis

Assumptions:
- Constant CERES, imager & spacecraft survival rates.
- Fuel is the only limiting factor for Terra & Aqua de-orbit dates
- 15-year mission for S-NPP, J1, J2, J3
- J2 launches in 2021 and J3 launches in 2026
- EV-C ERB instrument can be accommodated on J3

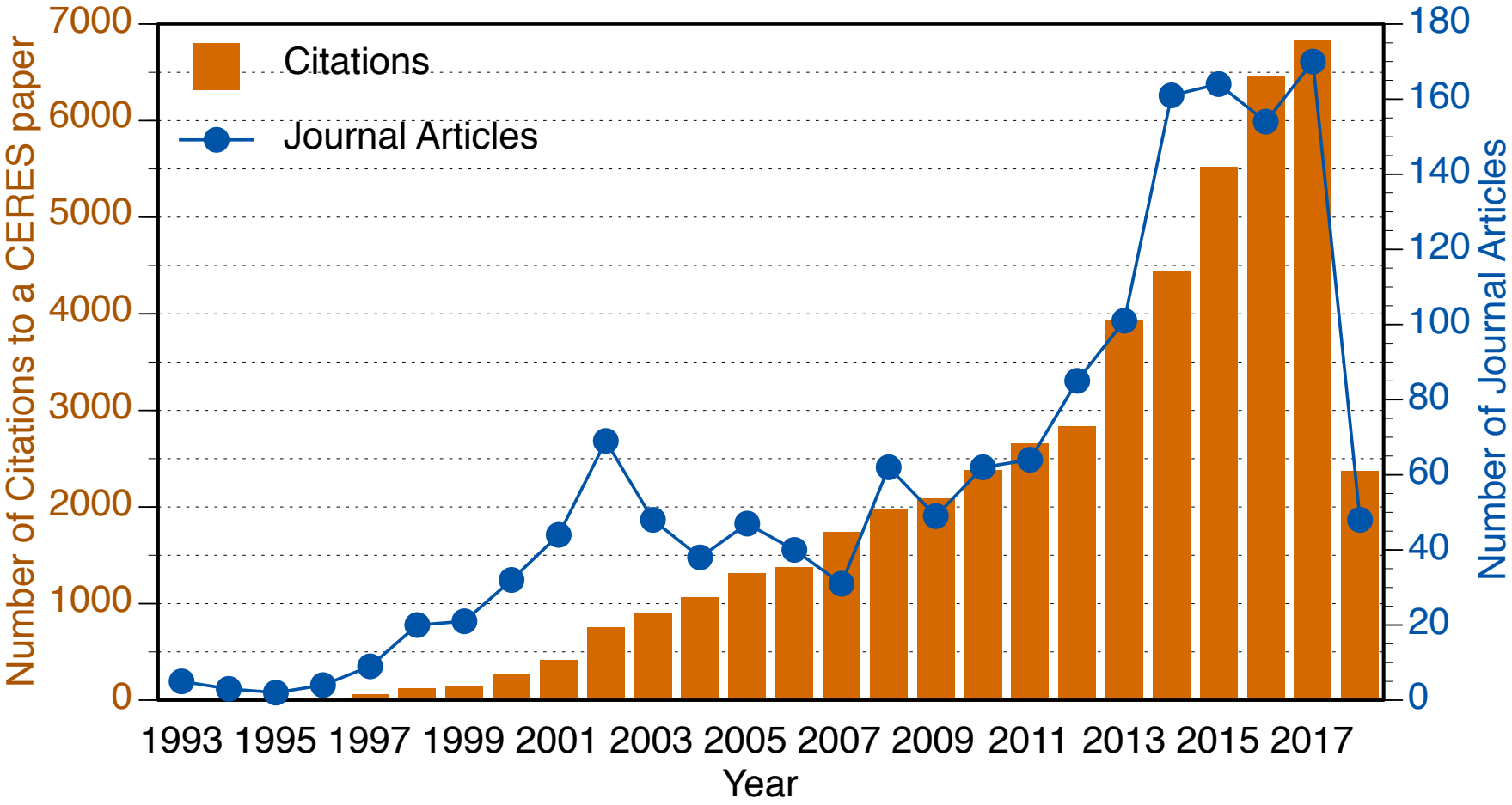


- The probability of a data gap in the ERB record reaches 51% in 2027 if no CERES follow-on launches before 2027.
- Launching a CERES Follow-on in 2026 reduces gap risk in 2027 to 30%.
- Had RBI flown on J2, the gap probability would have remained at ≈20% in 2027.

S-NPP Spacecraft Anomaly: Solar Array Output Event

- Anomaly Review Team (ART) continues to investigate the Solar Array Anomaly that occurred on April 2nd
- The Solar Array output remains stable
- **The Solar Array is producing approximately 30 Amps less (30%) of its output prior to the event**
- All telemetry shows that the Electrical Power Distribution System is stable and there is no indication of further degradation
- No operational changes are required at this time, as adequate power margin remains
- ART #6 held on May 1st
- BA continues investigate / assess on orbit observables in support of determining root cause
- The leading theory is a Solar Array connector failure between the inner panel and the middle panel (J8) has failed
- Power Margin analyses are being updated using on orbit actual telemetry
- **The S-NPP remains in nominal science mode with no operational changes or modifications**

CERES Journal Publications and Citation Counts
(For Papers Between 1993-2018; Updated May 11, 2018)



- Total number of peer-reviewed journal articles: 1,533
- Total number of citations to CERES papers: 49,655

(Compiled by Anne Wilber & Dave Kratz)

Number of Unique Users by CERES Data Product
(through April 30, 2018)

Level	Product	2010	2011	2012	2013	2014	2015	2016	2017	2018
1b	BDS	11	9	14	19	14	11	13	14	2
2	SSF	84	77	138	223	247	253	278	327	93
	FLASH_SSF	25	8	15	23	30	61	41	68	43
	C3M	31	32	33	37	28	55	54	49	21
	ES8	22	20	18	31	16	21	15	15	2
	SSF-MISR	9	4	2	5	4	2	1	3	0
3 & 3b	EBAF-TOA	72	160	346	484	579	580	540	646	273
	EBAF-Surface			147	289	375	424	464	510	177
	SYN1deg	70	139	188	331	375	431	483	607	303
	SSF1deg	77	126	107	157	166	160	194	190	69
	CldTypHist	17	12	37	57	41	40	47	86	23
	ES4	59	36	11	27	19	13	12	17	7
	ES9	21	12	5	13	9	5	5	8	3
	FLASH_TISA	17	18	20	17	15	15	36	52	18

CERES Terra and Aqua Data Product Availability

Data Product	Level	Ed4.0
BDS	1	04/2018
SSF	2	01/2018
SSF1deg	3	12/2017
SYN1deg	3	11/2017
CldTypHist	3	02/2017
EBAF-TOA	3b	11/2017
EBAF-SFC	3b	10/2017

Terra+Aqua Edition 4 Status

- The CERES Terra & Aqua Edition 4 reprocessing relies upon MODIS Collection 5 radiances and aerosols through February 2017.
- Starting in March 2017, MODIS Collection 6 imager data is be used, as MODIS Collection 5 processing at GSFC was be terminated.
- MODIS Collection 6 production at GSFC will continue through April 2018, and then be superseded by MODIS Collection 6.1.
- MODIS Collection 6.1 is a major calibration upgrade for select Terra (6.72 and 8.6 μm) and Aqua (visible) channels.
  - Will significantly improve the quality of the MODIS Terra water vapor channel (6.72 μm), which is used in the CERES cloud mask.
  - Entire MODIS C6.1 record is available.
- CERES Team will reprocess with MODIS C6.1 starting in March 2016, when the MODIS Terra water vapor channel showed a large spurious loss of sensitivity.
  - To mark the change, Edition 4.0 will be renamed to Edition 4.1.
  - CERES data through February 2016 will not be reprocessed until Edition 5.

S-NPP Edition1 Product Availability

Product	Platform	Processed through	Current	Publically Available
BDS	S-NPP	12/2017	Yes	Yes
SSF	S-NPP	12/2017	Yes	Yes
SSF1deg-Hour	S-NPP	11/2017	Yes	Yes
SSF1deg-Day/Month	S-NPP	11/2017	Yes	Yes
SYN1deg	Terra+S-NPP	11/2017	Yes	Yes

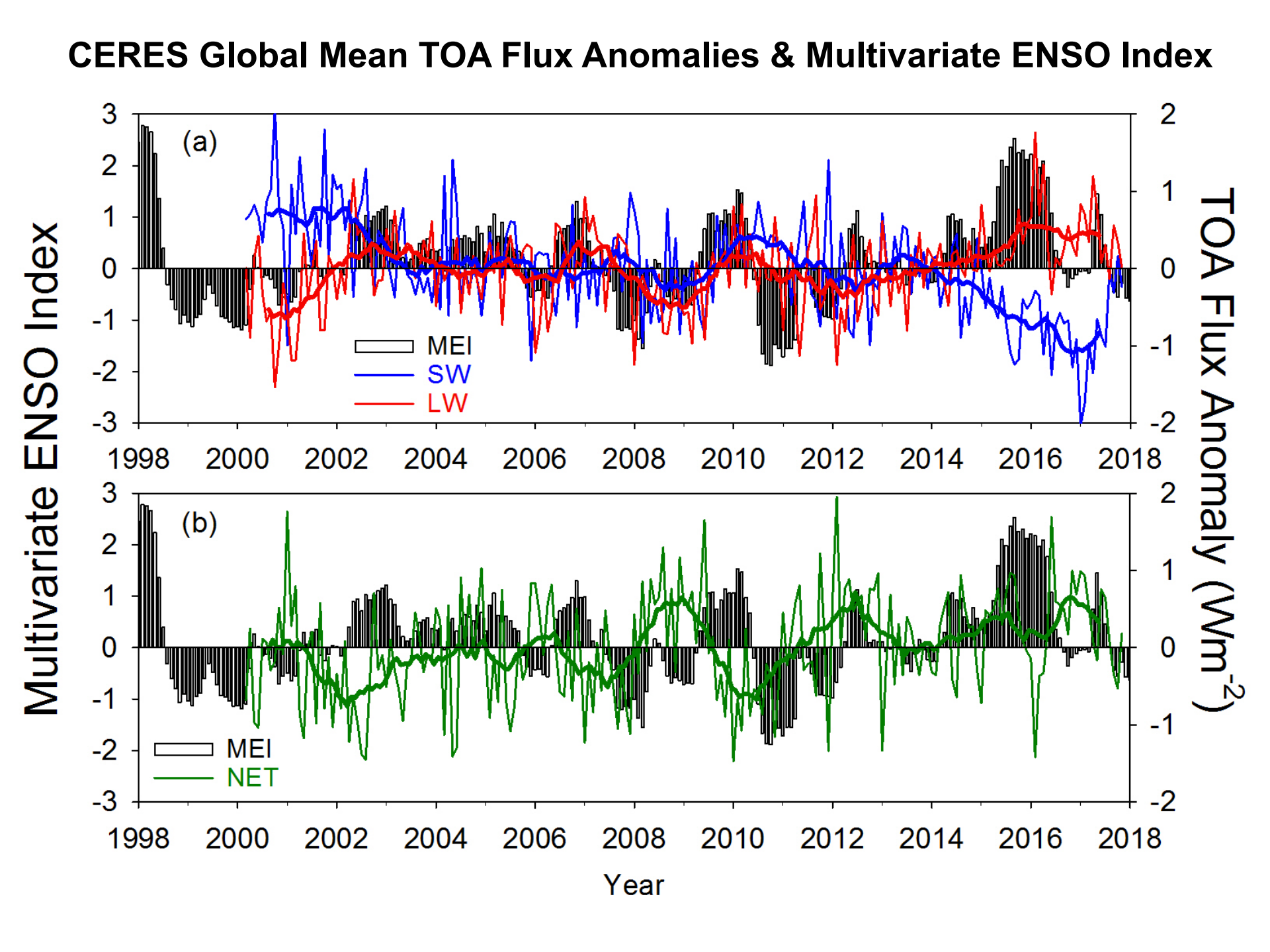
S-NPP Edition 2 Plans

- In Edition 1, instrument gains (from onboard calibration) were taken into account. No attempt was made to place FM5 on same radiometric scale as FM3 or correct for spectral response function changes with time.
- Cloud retrieval, ADMs, TISA & SARB algorithms were based upon those from Aqua.
  - Some changes to VIIRS cloud mask since water vapor and CO_2 bands are unavailable.
  - Cloud retrieval look-up tables were recomputed for VIIRS bands.
- S-NPP Edition 2:
  - Will place FM5 on same radiometric scale as FM3.
  - Will correct for FM5 spectral response function changes with time (LW daytime only).
  - Will place VIIRS on same radiometric scale as MODIS Aqua and use the latest version of VIIRS level 1b.
  - Key decision point: whether or not to ingest CrIS WV & CO_2 radiances
  - Will defer any other major algorithm changes to Edition 3 (e.g., Clouds, ADMs, TISA, SARB).

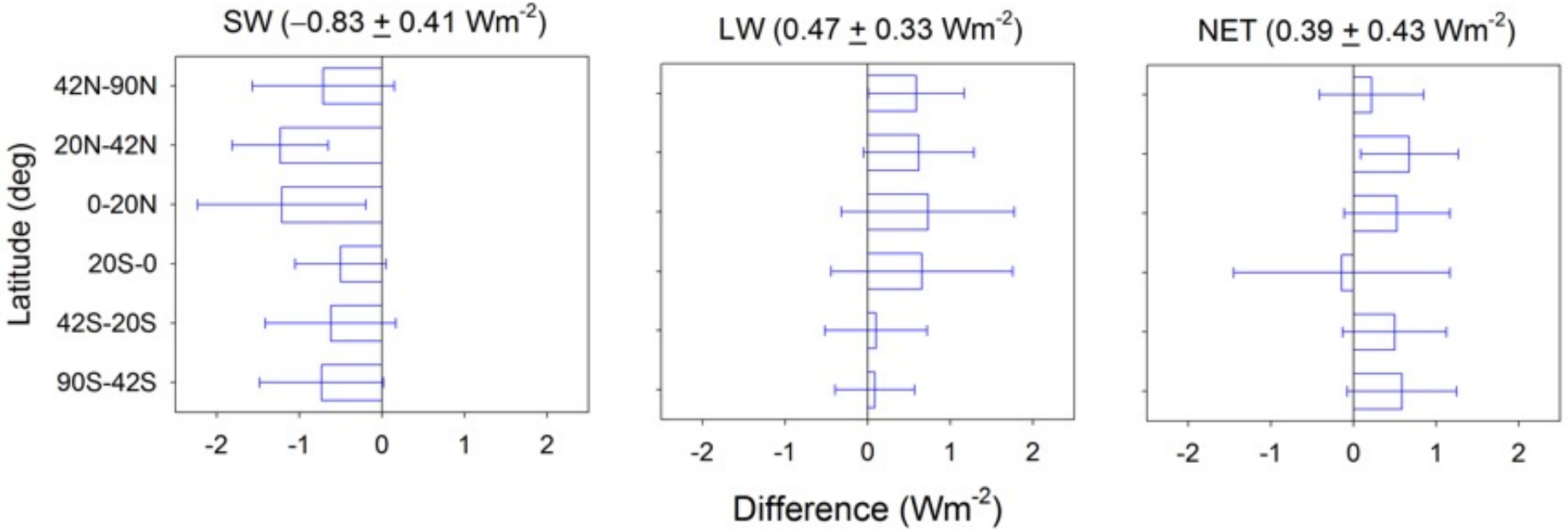
CERES Ocean Validation Experiment (COVE)

- All COVE instruments have been removed from the Chesapeake Lighthouse Tower and are currently at CAPABLE site at NASA LaRC.
- COVE instruments will be relocated to Granite Island, a 2.5 acre island located 5 miles offshore in Lake Superior.
- The island already hosts eddy covariance measurements for the Great Lakes Evaporation Network (GLEN).
- Hardware components are currently being assembled and tested at LaRC CAPABLE site.
- GSFC AERONET instrument were delivered to LaRC for integration with other components.
- Installation scheduled at Granite Island the week of June 4, 2018.
- First data will be presented at Baseline Surface Radiation Network meeting mid-July.

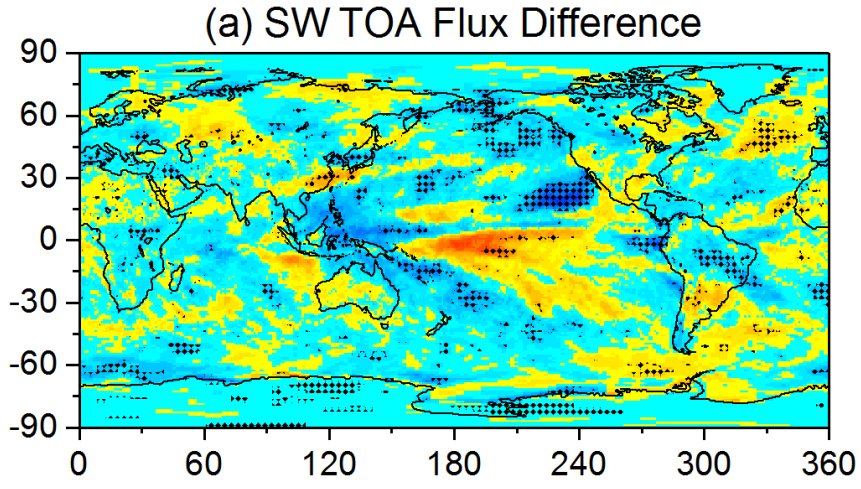
Granite Island

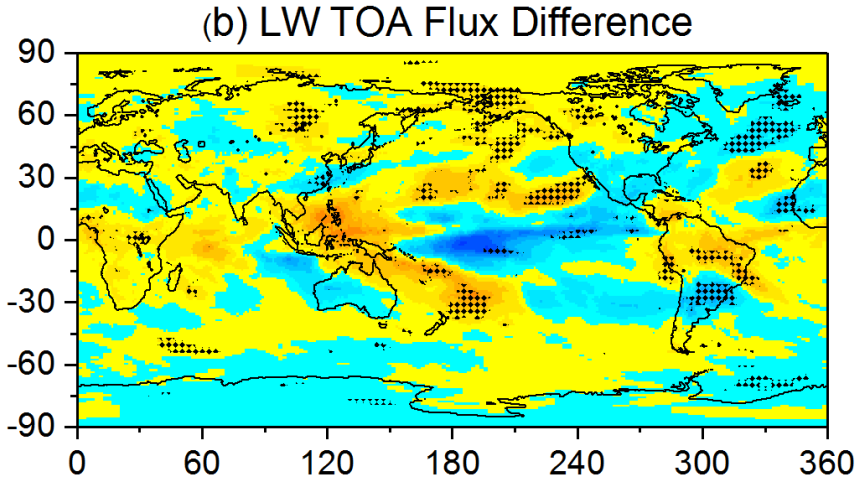

CERES Global Mean TOA Flux Anomalies & Multivariate ENSO Index
(a)
MEI
SW
LW
(b)
MEI
NET
Multivariate ENSO Index
TOA Flux Anomaly (Wm-2)
Year
3
2
1
0
-1
-2
-3
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018

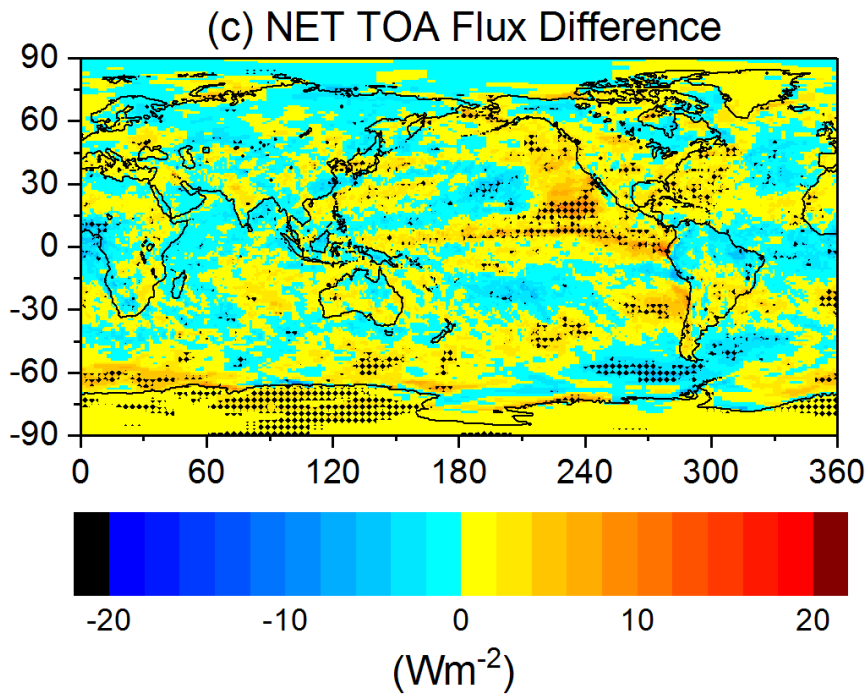
Zonal Mean Differences in TOA Radiation (07/2014-06/2017) minus (07/2000-06/2014)



Regional Mean Differences in TOA Radiation (07/2014-06/2017) minus (07/2000-06/2014)

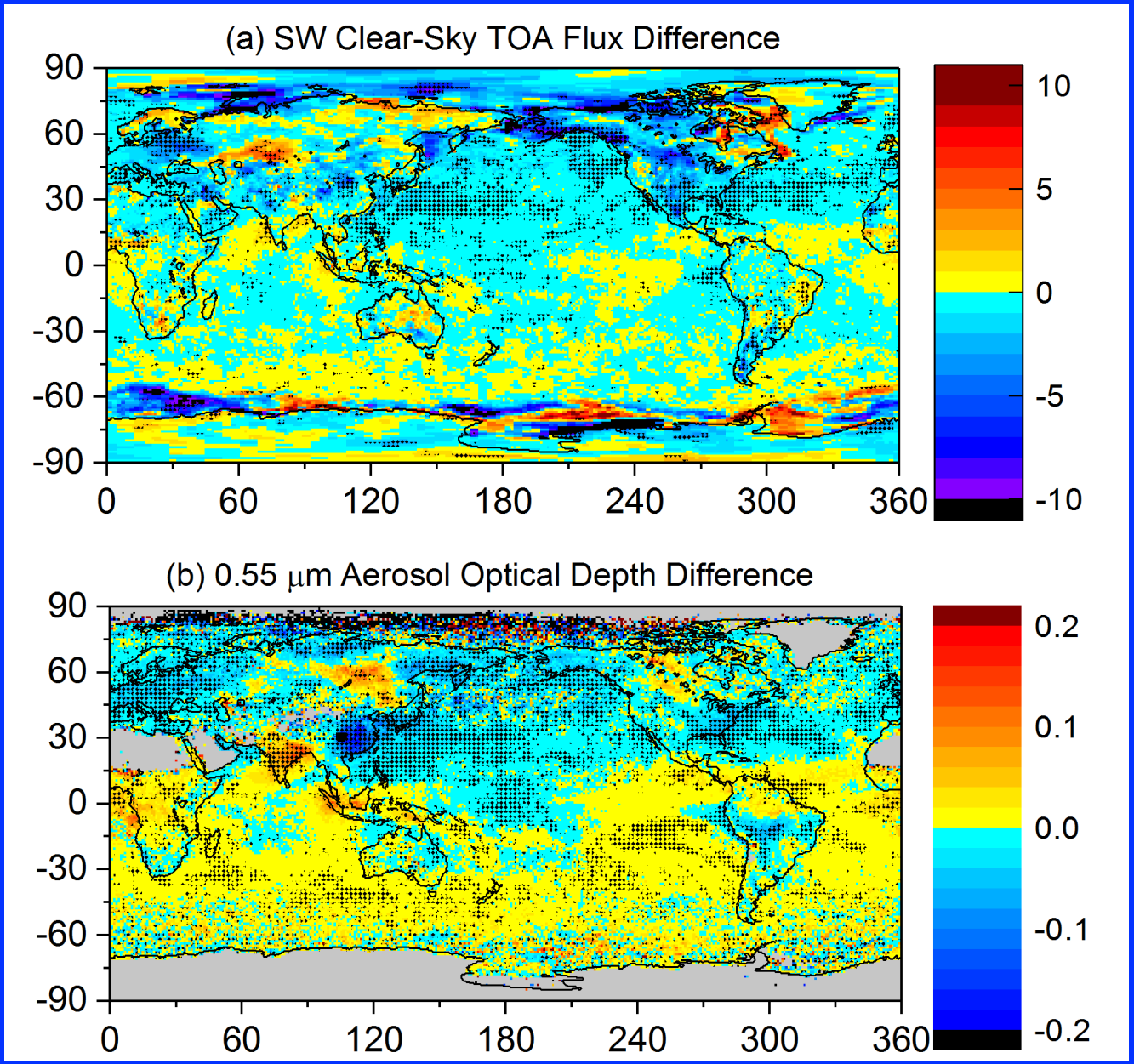






- TOA flux difference pattern in the tropics is dominated by ENSO.
- Substantial decrease in SW TOA flux (increase in net downward flux) over Eastern Pacific (especially off of CA) and N. Pacific Ocean.

Regional Mean Differences in SW Clear-Sky TOA Radiation & AOD (07/2014-06/2017) minus (07/2000-06/2014)



Upcoming Conferences & Meetings of Interest

AMS Radiation/Cloud Physics Conference
- July 9-13, 2018, Vancouver, British Columbia, Canada.

Fall 2018 Earth Radiation Budget Workshop (CERES/GERB/ScaRaB)
- September 10-13, 2018, NCAR, Boulder, CO.

CLIVAR/GEWEX Earth's Energy Imbalance Workshop
- November 13-16, 2018, Toulouse, France.

American Geophysical Union Fall Meeting
- December 10-14, 2018, Washington, DC.

End